

# EFFECT OF STORAGE AND CROPPING SYSTEM ON THE MAL D 1 CONTENT AND ISOALLERGEN PROFILE

J. KAESWURM<sup>a,b</sup>, L. STRAUB<sup>a,c</sup>, D. A. NEUWALD<sup>c</sup>, M. BUCHWEITZ<sup>a,b</sup>

## INTRODUCTION

**AN APPLE A DAY KEEPS THE DOCTOR AWAY – OR DOESN'T IT?**

- Apples are an important source of vitamins, fibers and secondary plant metabolites
- They are available on the market during the whole year, due to optimized storage techniques, slowing down senescence

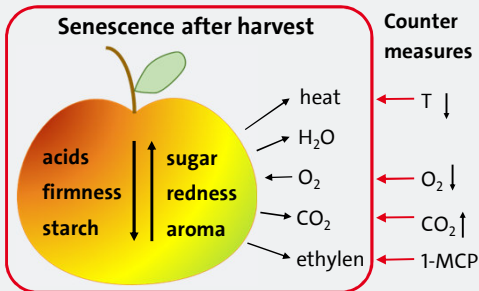


Fig. 1: Effects of senescence on apples after harvest and counter measures. 1-MCP: 1-methyl-cyclopropane is an ethylene blocker

- Estimated 70% of all birch pollinosis patients will also develop a cross allergy against fresh apples<sup>1</sup>
- Cause for this allergy is the allergen Mal d 1 and its structural similarity to the main allergen in birch, Bet v 1<sup>2</sup>
- A variety specific allergenicity has been observed in clinical studies and consumer surveys and it is assumed that the allergenic potential is affected by the Mal d 1 content and the isoallergen profile<sup>3-5</sup>
- An increase in Mal d 1 during storage is reported in literature<sup>6,7</sup>
- An Effect of cropping system on the Mal d 1 content is debated in literature<sup>6,8</sup>
- Individual biological replicates might also differ in the allergen content<sup>9</sup>

## MOTIVATION

Although, an effect of specific isoallergens on allergenicity is proposed, ELISA, which is widely used for Mal d 1 quantification, is not suitable to distinguish them.

Therefore, we investigated the impact of

- Storage time and conditions
- Cropping system
- Individual replicates

on the Mal d 1 content and isoallergen profile by mass spectrometry

## METHOD

- A bottom-up proteomic approach for isoallergen specific absolute quantification by isotope labeled peptides (ISTD)<sup>10</sup>
- Addition of a r-Mal d 1 (ESTD) allowed monitoring of Mal d 1 extraction efficiency

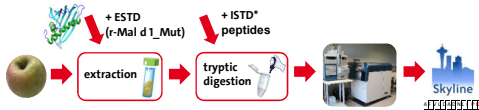


Fig. 2: Workflow of the bottom-up proteomics method

## RESULTS

### VARIATIONS AMONG BIOLOGICAL REPLICATES AND IMPACT OF THE CROPPING SYSTEM<sup>11</sup>

- Differences in the allergen content of up to 2.5 times among biological replicates
- Stable isoallergen profile within biological replicates
- No effect of cropping system (organic vs integrated production) on Mal d 1 content or isoallergen profile

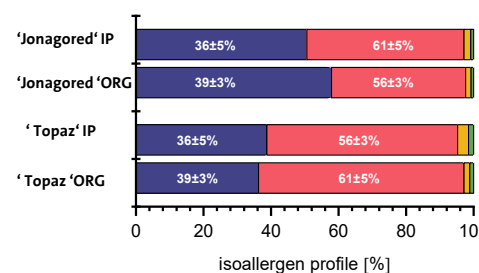
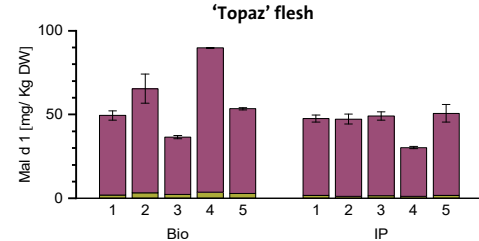
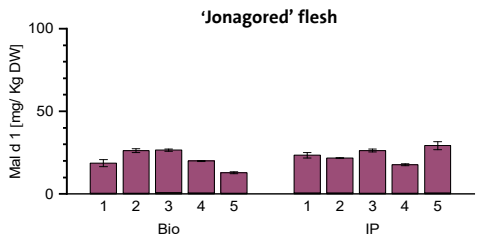


Fig. 3: Mal d 1 content and isoallergen profile in the flesh of 5 biological replicates grown by organic (ORG) or integrated (IP) production

## RESULTS

### IMPACT OF STORAGE<sup>11</sup>

- Increase in allergen content during storage
  - 1-MCP treatment before storage slows down Mal d 1 expression and prevents 1.03 and 1.06 accumulation
  - Isoallergens 1.03 and 1.06 accumulate during CA storage, while in RA storage only 1.06 increases
- Allergenicity of specific isoallergens is debated in literature and our previous results indicate an increased allergenic potential for 1.03 and 1.06<sup>12</sup>

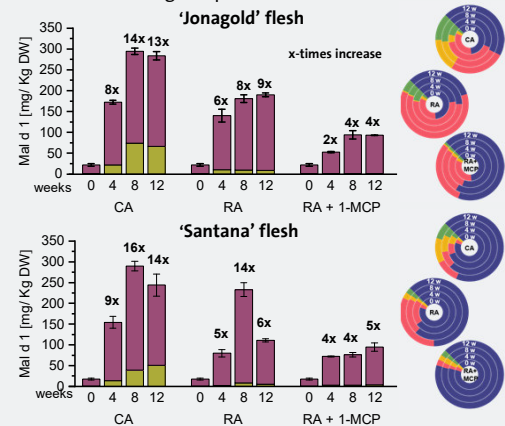


Fig. 4: Mal d 1 content and isoallergen profile in flesh during storage  
 CA – controlled atmosphere: 1.0 kPa O<sub>2</sub>, 2.5 kPa CO<sub>2</sub>, 1 °C ('Jonagold'), 1.0 kPa O<sub>2</sub>, <0.7 kPa CO<sub>2</sub>, 1 °C ('Santana'); RA – regular air: 1 °C; RA+1-MCP – 1 °C+1-MCP

## TAKE HOME MESSAGES OF THE PILOT STUDY

- Significant variations in the Mal d 1 content within biological replicates
  - No effect of the cropping system on Mal d 1
  - Mal d 1 increase and changes in isoallergen profile dependent on storage condition
- Further studies about storage effects are required  
 → Storability must be considered when evaluating variety specific allergenicity  
 → Analytical characterization of individual apples in clinical studies is essential

## KONTAKT:

**JULIA KAESWURM**  
 AG Buchweitz – Polyphenol-Matrix Interaktionen  
 Institut für Lebensmittelchemie  
 Fachbereich Chemie  
 E-Mail: julia.kaeswurm@uni-hamburg.de  
 Büro HS 005 – Martin-Luther-King-Platz 6

PROJEKT WURDE GEFÖRDERT DURCH DIE DFG

